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IMPACT OF AGRISPON (A SOIL SUPPLEMENT) ON SOIL FAUNA IN MAIZE FIELDS AT FAYOUM GOVERNORATE, EGYPT

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ABSTRACT

An experiment was conducted at Demo village, Fayoum Governorate during the period between May and September 1999, in order to study the impact of Agrispon on the activity density of soil fauna in maize fields. Samples of the soil fauna were collected by the pitfall trap method. Data obtained were treated by multivariate statistical methods, correspondence analysis and ascending hierarchic classification. The Agrispon-treated plot had low numbers of soil fauna and which became slightly higher when organic manure was added to the plot before using Agrispon. These numbers were normally high in the untreated plot. The three main functional (trophic) groups, namely predators, herbivores, and detritivores, were well represented in the different treatments. Agrispon-treated soil comprised a lower number of herbivorous insects and created conditions suitable for detritivores to become abundant and opened the way for predators to act on their prey (herbivores).

INTRODUCTION

The agronomic significance of the soil fauna (other than pest species) depends upon the intensity of cropping systems, because grazing, fire, tillage, inorganic fertilizers and pesticides generally reduce the species complement and population densities of the soil fauna, and override their contribution to soil processes (Anderson, 1988). However, addition of N fertilizer increases soil fauna populations (Sharshir, 1998). Investigations on the effects of conventional and organic farming methods on the soil fauna made by Pfeiffer (1996) revealed that organic methods enhanced the diversity and abundance of most beneficial soil animals.

The scale at which the animals affect soil processes and their overall contribution to ecosystem-level processes is related to the body size and population densities of the animals as well as their burrowing and feeding activities (Anderson, 1988). Such effects are: the hydrology of soils, and hence soil erosion and nutrient leaching from the system. On the other hand, population densities of soil animals and their functional (trophic) groups are responsible to a great extent for N mineralization in such agro-ecosystem

(Persson, 1983). Most of this mineralization is effected by bacterivores, fungivores and carnivores, where all feed on N-rich food, whereas saprovores and herbivores, that feed on N-poor food, have little influence on N mineralization.

The use of such compounds to improve the soil condition and increase crop production is adopted at present. Botanical extractives, as non-toxic biorational substances, are capable of bringing soil-plant-pest-associated natural enemies system into balance (Oteifa, 1994). One of these compounds is Agrispon. Agrispon may produce several effects within the soil-plant system. Its soil effects include: increased number and activity of certain soil organisms, especially those in the rhizosphere, improved soil structure and tilth over time, and increased content and availability of soil nitrogen, and sometimes phosphorous (Anonymous, 1990; Guerra and Guzmen, 1995; Dubravek *et al.*, 1995 a and b). This may affect abundance and diversity of soil animals. To our knowledge, such a study has never been given attention, and so the aim of the present work is to study the effect of adding Agrispon to fields on the activity density of soil fauna and their functional (trophic) groups in maize fields at Fayoum Governorate.

MATERIAL AND METHODS

The study area

The experiment was conducted at Demo village, Fayoum Governorate during the period between May and September 1999. An area of three feddans was selected and divided into 3 equal plots, one feddan each. These plots were cultivated with maize (Fardy hybrid 10). In the first plot, after the plant reaches 50 cm height, Agrispon was sprayed on the plant and the soil around it at the recommended rate of 450 cm^3/feddan. The second plot was treated with organic manure also at the recommended rate. After its addition to the soil, Agrispon was sprayed onto the soil before sowing maize seeds at a rate similar to that of the first plot. The third plot was left untreated. Normal agricultural practices were followed in this plot, including the addition of N-chemical fertilizer. Samples of the soil fauna were collected from the treated and untreated plots at 3 intervals, namely after application of the treatment, the middle of the growing period and just before harvesting.

The experimental material

Agrispon is the registered trade name for a soil supplement which, when applied to the soil, plants, or seeds evokes diverse positive growth responses with plants, and assists in upgrading soil conditions. It is composed of inorganic elements, organic compounds and water (Anonymous, 1990).

The inorganic elements (average amount mg/l) include: Potassium (2200), Chloride (700), Nitrate (700), Sodium (209), Sulfate (110), Silica (72), Boron (60), Aluminium (26), Mercury (25), Iron (23), Magnesium (7.6), Phosphorus

(5), Calcium (4), Copper (2.3), Manganese (0.4), Selenium (0.295), Nickel (0.288), Cobalt (0.057), Antimony (0.036), Chromium (0.0204), Barium (0.012), Lead (0.01), Silver (0.005), Cadmium (.0015) and Molybdenum (trace).

The organic compounds (average amounts mg/l) include: organic matter (130) and dissolved solids (8000). Types of the organic compounds within the organic matter fraction are: Porphyrins, Morphogens, Cytockenin-like Phytohormones and Glycosides.

Method of sampling soil fauna

Samples of the soil fauna were collected from the study area by the pitfall trap method as described by Slingsby and Cook (1986) and Southwood and Henderson (2000). In this method, the number of individuals trapped is primarily dependent on their locomotory activity (Greenslade and Greenslade, 1983; Kromp, 1990; Mikhail, 1993). These are called activity densities rather than population densities (Kromp, 1990; Mikhail, 1993; Mikhail *et al.*, 1995; Mikhail and Hussein, 1997) and can not be related to the abundance per unit area (Kromp, 1990) but are taken as number per trap (Mikhail, 1993; Mikhail *et al.*, 1995; Mikhail and Hussein, 1997).

Ten traps were used in each sampling date in the different plots. The number of fauna collected is the total number of individuals/10 traps. Average numbers were multiplied by 10 to avoid decimal fraction.

Treatment of data

Data of the activity density of the soil fauna were treated by multivariate statistical methods: correspondence analysis CA (Greenacre 1984) and ascending hierarchic classification AHC (Roux 1985). The computer calculations for CA and AHC were carried out at Cairo University using DATAVISION programme 1.2 (Roux, 1987) developed for APPLE IIe in BASIC.

RESULTS

Table 1 shows results of activity density of species and/or higher taxa of soil fauna collected in the present study from the three treatments: Agrispon, organic manure + Agrispon and untreated plots.

Fig. 1 shows the results of the application of CA and AHC methods to data of Table 1. Seventy percent of the total variance is associated with the first (horizontal) axis and 30% with the second (vertical) axis. The first axis separates the untreated plot at one side and the other two treated plots at the other side of the ordination graph. The second axis separates the first plot, treated with Agrispon only, and the third untreated plot, both at the upper part and the second plot treated with organic manure and Agrispon at the lower part. The first plot, treated with agrispon only, is characterized more or less by Diptera including Muscidae, the coleoptrans *Anthicus* spp., *Leptacinus* spp., *Paederus alfierii*,

Tachys spp., *Microlestes* spp., *Pheropsophus parallelus*, *Stilbium* spp., Curculionidae, *Choeon* spp. and *Gryllotalpa gryllotalpa*. The second plot, treated with organic manure and agrispon is characterized by 9 species and/or higher taxa. These were: *Camponotus aegyptiacus*, *Musca domestica*, *Sarcophaga dux*, Micro-Lepidoptera, Cixiidae, Mantidae, Acrididae, *Schistocerca gregaria* and *Gryllus bimaculatus*. The untreated plot was characterized more or less by Spiders, Hymenoptera, *Monomorium salmonis*, *Drapetis* spp., *Oxytelus lativsculus*, *Coccinella* larvae, Lepidoptera larvae, *Chrysopa vulgaris*, *Lepidocyrtinus* spp., *Labidura riparia*, Lygaeidae, Homoptera, Aphididae and *Gryllus domesticus*.

Fig. 2 shows the results of the breakdown of soil fauna of the present study into the three main functional (trophic) groups namely predators, herbivores, and detritivores; under different treatments. Generally, the Agrispon-treated plot has low numbers of soil fauna and these numbers became slightly higher when organic manure was added to this plot before using Agrispon. These numbers were higher in the untreated plot. Total activity density of species and/or higher taxa of herbivores were low in Agrispon-treated plot and higher in the untreated plot, whereas they were moderate in the Agrispon + organic manure-treated plot. Predators were equal in both Agrispon- and Agrispon + organic manure-treated plots, but they were slightly higher in the untreated plot. Detritivores were high in the untreated plot and lower in Agrispon + organic manure-treated plot, while they were moderate in Agrispon-treated plot.

DISCUSSION

The effects of different fertilizer regimes on the populations of earthworms and beneficial arthropods found in a wheat field was studied by Kromp *et al.* (1996). The results of the present study indicate that the Agrispon-treated plot had low numbers of soil fauna and they became slightly higher when organic manure was added to that plot before using Agrispon. The numbers were higher in the untreated plot. Inspite of the difference between the present investigation and that of Kropm *et al.* (1996) in the cover crop, the effect of such fertilizer regimes on the abundance and diversity of soil animals is comparable.

Increasing N rate increased the fauna population (Sharshir, 1998) as in the untreated plot which received N-chemical fertilizer. This plot was characterized by the abundance of Collembola, a detritivore soil fauna which were greatest in soils treated with mineral fertilizer plus mulch (Sautter *et al.*, 1998). However, nitrogenous amendment decreased the numbers of Collembola (Deleporte and Tillier, 1999) in the Agrispon- and Agrispon + organic manure-treated plots. Though chemical N fixation potential of Agrispon have been mentioned through such studies (Anonumous, 1990), which revealed a slow but steady increase in nitrate levels in some cases, sterilization of both the media and the Agrispon was observed. It was calculated that 72.47 kg of N/ha could be fixed in 300 days if

the rate produced in such experiment continued that long. In the present investigation, maize was cultivated in mid may and continued in the soil for about 130 days. This could lead to lack of nitrogen in Agrispon and manure + Agrispon-treated plots in comparison with the great amount of nitrogen in the untreated plot. This may explain the variation in number of soil fauna in the three plots of the present study.

Community structure of such agro-ecosystem could be represented by studying of the functional (trophic) groups in order to evaluate their balance and structural composition in the ecosystems (Ghabbour, 1991). The three main functional groups are herbivores (potential agricultural pests), carnivores (natural enemies of herbivores), and detritivores (essential of soil fertility). The presence of these three main functional groups illustrates the degree of complexity of food chains and their balance state in such ecosystem as in cases of potato fields (Mikhail and Hussein, 1997), other tuber crops (Hussein and Mikhail, 1998) and vegetable crops (Hussein *et al.*, 1998).

Beneficial effects of microorganisms on soils due to Agrispon application may, as for plants, be direct or indirect. Direct effects are through enhanced growth of soil fungi, bacteria, and other species which produce more mucilagenous gums and other substances necessary for optimum soil structure. Indirect effects are due to enhanced root growth of crops, with a greater rhizosphere influence throughout the soil mass. Thus, more organic matter produced, microorganisms activity is enhanced and the gums and other decomposition products needed to produce a strong, stable soil structure are increased (Anonymous, 1990). In addition, Agrispon-treated soil reduced the number of herbivorous insects and created conditions suitable for detritivores to become abundant and open the way for predators to act on their enemies (herbivores).

REFERENCES

Anderson, J. M. (1988). The role of soil fauna in agricultural systems. Proceedings of the Symposium on Advances in Nitrogen Cycling in Agricultural Ecosystems, Brisbane, Australia, 11-15th May 1987, CAB International: 89-112.

Anonymous (1990). Agrispon: A totally new way to nature work. Ministry of Agriculture, Egypt: 14 pp. (Booklet).

Deleporte, S. and Tillier, P. (1999). Long-term effects of mineral amendments on soil fauna and humus in an acid beech forest floor. Forest Ecol. Manage., **118 (1-3):** 245-252.

Dubravek, K.; Dubrevec, I. and Manitasevic, J. (1995a). The effect of bioregulators Agrispon and Ergostim on the vegetative and reproductive growth of apples. J. Sust. Agric., **5 (1/2):** 73-83.

Dubravek, K.; Dubrevec, I. and Manitasevic, J. (1995b). Influence of bioregulators on the leaves pigments level and yield of apple. Acta Pharmacol. Sin., **45:** 253-257.

Ghabbour S. I. (1991). Towards a zoosociology of soil fauna. Rev. Ecol. Biol. Sol, **28:** 77-90.

Greenacre, M. J. (1984). Theory and Application of Correspondence Analysis. Academic press, London: 363 pp.

Greenslade, P. J. M. and Greenslade, P. (1983). Ecology of soil invertebrates. In: "Soils: An Australian Viewpoint". Division of Soils, CSIRO: 645-669.

Guerra, E. and Guzmen, F. (1995). Agrispon and nitrogen effect on *Phaseolus vulgaris* L. inoculted with *Rhizobium phaseoli*. Universalia, **2(1):** 11-20.

Hussein, A. M. and Mikhail, W. Z. A. (1998). Evaluation of agricultural pests in tuber crop plantations in Menofiya Governorate. Menofiya J. Agric. Res., **23(3):** 639-649.

Hussein, A. M.; Mikhail, W. Z. A.; Eid, T. M. and H. M. El-Khatib (1998). Populations of functional groups of soil mesofauna in non-tuber vegetable crops in Menoufiya. Ann. Agric. Sc. Moshtohor, **37 (2):** 2035-2048.

Kromp, B. (1990). Carabid beetles (Coleoptera, Carabidae) as bioindicators in biological and conventional farming in Austrian potato fields. Biol. Fert. Soils, **9:** 182-187.

Kromp, B.; Pfeiffer, L.; Meindl, P.; Hartl, W.; Walter, B.; Finch, S. and Brunel, E. (1996). The effects of different fertilizer regimes on the populations of earthworms and beneficial arthropods found in a wheat field. In: "Integrated Control in Field Vegetable Crops. Proceedings of the meeting, held in Guitte, France, 6-8 November, 1995. Bulletin-OILB-SROP. 1996, **19 (11):** 184-190.

Mikhail, W. Z. A. (1993). Effect of soil structure on soil fauna in a desert wadi in Southern Egypt. J. Arid Environ., **24:** 321-331.

Mikhail W. Z. A. and Hussein A. M. (1997). Activity density of soil mesofauna associated with potato fields in Menofiya Governorate, Egypt. Egypt. J. Zool., **28:** 139-147.

Mikhail, W. Z. A.; Abdel-Halim, S. M. and Rizk, M. A. (1995). Effect of bio-pesticide and chemical insecticide treatments on some non-target soil fauna at Fayoum Governorate, Egypt. J. Union Arab Biol., **3(A):** 265-287.

Oteifa, B. A. (1994). Incorporating biorational substances as new approaches within IPM program. Proc. Crop Health Conf. Fayoum, Egypt: 569-581.

Pfeiffer, L. (1996). Which farming methods enhance faunal diversity? Agrarforschung, **3:** 11-12.

Persson, T. (1983). Influence of soil animals on nitrogen mineralization in a northern Scots pine forest. In: P. New Trends in Soil Biology. Lebrun; H. M. Andre and A. Medts (eds.): 117-126.

Roux, M. (1985). Algorithmes de Classification. Masson.,Paris: 151 pp.

Roux, M. (1987). DATAVISION 1.2 logociel d'analyse de donnees. Montpellier, CEPE/CNRS. 30 pp.

Sautter, K. D.; Motta-Neto, J. A.; Moraes, A.; Santos, H. R.; Ribeiro-Junior, P. J.; de-Moraes, A. and dos-Santos, H. R. (1998). Population of oribatids and Collembola in pastures reclaimed from degraded land in a schist mine. Pesquisa Agropecuaria Brasileira, **33 (9):** 1509-1513.

Sharshir, F. A. (1998). Effect of three conventional tillage systems and fertilizer applications on soil Acarina and Collembola populations inhabiting faba bean (*Vicia faba* L.) cultivation in Kafr El-Sheikh. Ann. Agricultural Sci., Cairo, Special Issue, **3:** 957-971.

Slingsby, D. and Cook, C. (1986). Practical Ecology. MacMillan, London: 213 pp.

Southwood, T. R. E. and Henderson, P. A. (2000) Ecological Methods. Blackwell Science Ltd., Oxford: 574 pp.

Table (1) Activity density of soil fauna in different fertilizer treatments.

Taxa	Agrispon	Manure + Agrispon	Untreated
Spiders	57	143	155
Hymenoptera		8	15
Formicidae			
Monomorium salmonis	53	48	205
Camponotus aegyptiacus	10	45	20
Diptera	10	8	
Muscidae	53	15	
Musca domestica	17	53	15
Sarcophagidae			
Sarcophaga dux		15	
Empididae			
Drapetis spp.		3	5
Coleoptera			
Anthicidae			
Anthicus spp.	223	50	15
Staphylinidae			
Leptacinus spp.	3		
Oxytelus lativsculus		5	5
Paederus alfierii	20	10	15
Carabidae			
Tachys spp.	37	33	
Microlestes spp.	10	5	
Pheropsophus parallelus	137	53	
Phalacridae			
Stilbium spp.	3		
Coccinellidae			
Coccinella larva			10
Curculionidae	3	3	
Lepidoptera			
Lepidoptera larva			20
Micro-Lepidoptera		10	
Ephemeroptera			
Baetidae			
Choeon spp.	3		

Table (1) Continued

Taxa	Agrispon	Manure + Agrispon	Untreated
Neuroptera			
Chrysopidae			5
Chrysopa vulgaris			
Collembola			
Entomobryidae	70	113	435
Lepidocyrtinus spp.			
Dermaptera			
Labiduridae		8	35
Labidura riparia			
Hemiptera	13	23	50
Lygaeidae	17		30
Homoptera	27	80	395
Aphididae		48	
Cixiidae			
Dictyoptera		3	
Mantidae			
Orthoptera		3	
Acrididae	3	23	
Schistocerca gregaria			
Gryllidae	7		10
Gryllus domesticus		5	
Gryllus bimaculatus			
Gryllotalpidae	3		
Gryllotalpa gryllotalpa			

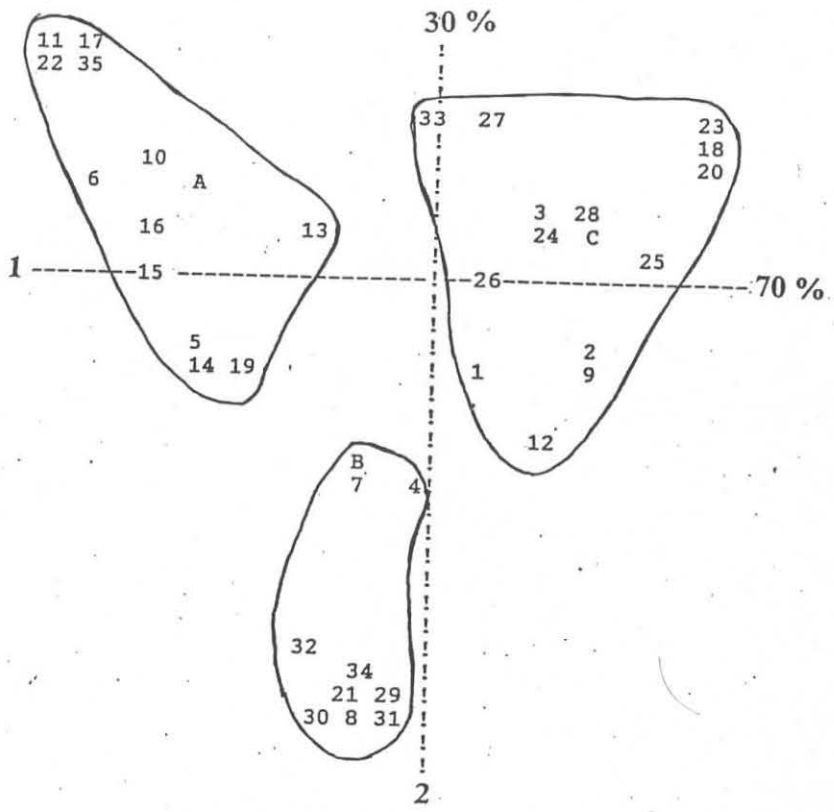

Fig. (1) Graphical representation of the application of CA and AHC methods to data of Table (1). Letters A-C, treatments, A, Agrispon treated plot; B, organic manure + Agrispon treated plot; C, untreated plot. Numbers 1-35, species and/or higher txa, 1, Spiders; 2, Hymenoptera; 3, *Monomorium salmonis*; 4, *Camponotus aegyptiacus*; 5, Diptera; 6, Muscidae; 7, *Musca domestica*; 8, *Sarcophaga dux*; 9, *Drapetis* spp.; 10, *Anthicus* spp.; 11, *Leptacinus* spp.; 12, *Oxytelus lativsculus*; 13, *Paederus alfierii*; 14, *Tachys* spp.; 15, *Microlestes* spp.; 16, *Pheropsophus parallelus*; 17, *Stilbium* spp.; 18, *Coccinella* larva; 19, Curculionidae; 20, Lepidoptera larva; 21, Micro-Lepidoptera; 22, *Choeon* spp.; 23, *Chrysopa vulgaris*; 24, *Lepidocyrtinus* spp.; 25, *Labidura riparia*; 26, Lygaeidae; 27, Homoptera; 28, Aphididae; 29, Cixiidae; 30, Mantidae; 31, Acrididae; 32, *Schistocerca gregaria*; 33, *Gryllus domesticus*; 34, *Gryllus bimaculatus*; 35, *Gryllotalpa gryllotalpa*.

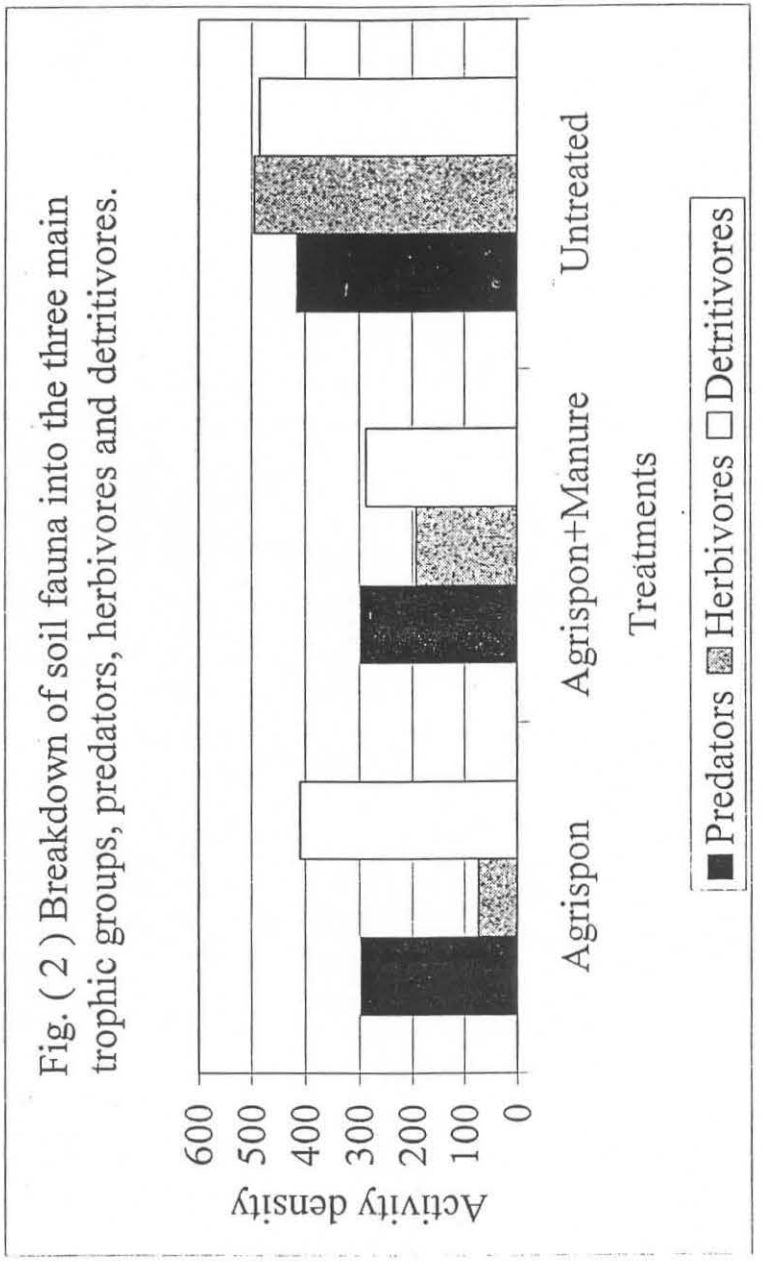

Fig. (2) Breakdown of soil fauna into the three main trophic groups, predators, herbivores and detritivores.

تأثير إضافة الأجرسبون (كمحسن للتربة) على حيوانات التربة فى زراعات الذرة بمحافظة الفيوم – مصر

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أجـريت هـذه التجربة فى قرية دمو بمحافظة الفيوم خلال الفترة من مايو الى سبتمبر ١٩٩٩ ، وذلك لدراسة أثر اضافة مركب الاجرسبون الى النبات والتربة فى زراعات الذرة . اختير حقل مساحته ثلاثة أفدنة وقسم الى ثلاث قطع متساوية المساحة (فدان واحد) . زرعت الأرض بمحصول الذرة (فردى هجين ١٠) ، أضيف الأجرسبون الى القطعة الأولى بعد ان وصـل النـبات الى ارتفـاع ٥٠ سم وذلك بمعدل ٤٥٠ سم^{3} للفدان ، فى هذه القطعة تم رش المـركب عـلى النبات وعلى سطح التربة حوله . وفى القطعة الثانية أضيف السماد البلدى ثم رش مـركب ا لأجرسبون بنفس المعدل المستخدم فى القطعة الاولى وذلك قبل الزراعة ، أما القطعـة الثالـثة فقـد تـركت بـدون معاملات ، وقد اتبعت فى القطعة الأخيرة المعاملات الـزراعية المعـتادة ومنها اضافة الأسمدة النيتروجينية . وقد جمعت حيوانات التربة بطريقة مصـائد الحفـر ، وحلـلت النتائج إحصائيا باستخدام الطرق الإحصائية المتقدمة مثل التحليل التوافقى والتقسيم الهيراركى .

وقـد اظهـرت النتائج نقص أعداد حيوانات التربة فى المساحة المعالجة بالأجرسبون فقـط ، و ازدادت هذه الأعداد نتيجة لإضافة السماد البلدى مع الأجرسبون فى القطعة الثانية بيـنما كـانت هذه الأعداد كبيرة فى القطعة الثالثة نتيجةلإضافة الاسمدة اننيتروجينية. وكانت المجموعـات الوظيفيـة الرئيسية الثلاث ممثلة فى المعاملات الثلاث ، كانت أعداد المفترسات وآكـلات النثار (آكلات البقايا النباتية والحيوانية) عالية فى المعاملات الثلاث. بينما اوضحت الدراسـة نقـص أعداد العاشبات الدقيقة الحجم فى القطع المعاملة بالأجرسبون عن تلك غير المعامـلة ، حيـث كانت الظروف مناسبة لزيادة أعداد آكلات النثار والمفترسات التى عملت على الحد من أعدادفرائسها (العاشبات).